Designation: D7127 – 05

StandardTest Method for Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces Using a Portable Stylus Instrument[1]

This standard is issued under the fixed designation D7127; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method describes a shop or field procedure for determination of four roughness characteristics of surfaces prepared for painting by abrasive blasting. The procedure uses a portable skidded or non-skidded stylus profile tracing instrument. The three measured characteristics are: *Rt*, *Rmax*, and *Pc*.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 In general, this method should be limited to the measurement of surface roughness where *Rmax* is in the range 10 to 150 µm (0.4 to 6 mil) and where the Peak Count, *Pc*, is less than 180 peaks/cm (450 peaks/in.).

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASME Standard:*

ASME B46.1-2002 Surface Texture, Surface Roughness Waviness and Lay[2]

2.2 *ISO Standards:*

ISO 4287: 1997 Geometrical Product Specifications (GPS)—Surface Texture: Profile Method—Terms, Definitions, and Surface Parameters[3]

3. Terminology

3.1 *Definitions*—The following definitions are provided as an aid to users of this document. Formal definitions of the surface roughness and instrument parameters below are contained in the referenced standards.

3.1.1 *deadband, n*—that distance above and below the mean line that a continuous trace line must cross in both directions (up and down) to count as a single peak.

3.1.1.1 *Discussion*—Use of a deadband diminishes the effect of small, spurious peaks due to noise.

3.1.2 *evaluation length, n*—a sequence of five consecutive sampling lengths.

3.1.3 *Pc, n*—the number of peak/valley pairs, per unit of length, extending outside a "deadband" centered on the mean line.

3.1.4 *Rmax, n*—the largest peak to valley measurement is determined from the five sampling lengths, and the largest of these five values is *Rmax*.

3.1.5 *Rt, n*—the distance between the highest peak and the lowest valley within any given evaluation length.

3.1.6 *sampling length, n*—the nominal interval within which a single value of a surface parameter is determined.

3.1.7 *surface preparation, n*—the cleaning and profiling of a metallic surface using an abrasive blast media or mechanical means to prepare that surface for coating.

3.1.8 *surface profile, n—for purposes of the standard*, the positive and negative vertical deviations (peaks and valleys) are measured from a mean line approximately the center of the profile being evaluated.

3.1.9 *surface roughness, n*—the combined characteristics of surface profile (height) and peak count (linear density) for a surface.

3.1.10 *traversing length, n*—seven sampling lengths comprising the evaluation length and the pre-travel and post-travel segments.

4. Summary of Test Method

4.1 This test method describes the proper use of a portable stylus surface roughness measuring device to evaluate specific surface parameters and evaluate their suitability for the application of the selected coating to the surface being prepared by abrasive blasting, or other mechanical means, prior to application.

[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.46 on Industrial Protective Painting.

Current edition approved Dec. 1, 2005. Published January 2006. DOI: 10.1520/D7127-05.

[2] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

[3] Available from International Organization for Standardization (ISO), 1 rue de Varembé, Case postale 56, CH-1211, Geneva 20, Switzerland.

4.2 The method describes considerations relevant to setup of stylus instruments for acquisition of required surface roughness parameters.

5. Significance and Use

5.1 This method may be useful in assuring conformance of a prepared surface to profile requirements specified by the manufacturer of a protective coating.

5.2 This method includes determination of the peak density (number of profile peaks in a specified distance). Some workers in the field believe that optimizing peak height and peak density can improve coating adhesion.

5.3 This method allows specifiers to objectively define surface texture after abrasive blast cleaning rather than using subjective terms such as "angular pattern" or "dense and uniform pattern."

6. Apparatus

6.1 The apparatus consists of a portable skidded or non-skidded electronic surface roughness measurement instrument ("tester") capable of measuring *Rt*, *Rmax* in compliance with ISO 4287 and *Pc* in compliance with ASME B46.1. In 2004 there are believed to be at least five manufacturers of such devices.[4]

6.2 The apparatus should include a stylus with a tip radius of 5 µm (0.2 mil), and permit recording of *Rt* and *Rmax* in the range 10 to 150 µm (0.4 to 6 mil) and *Pc* up to 180/cm (450/in.).

6.3 Surface deviations are sensed by the stylus and converted to electrical signals within the device. Internal processing converts these signals into standard surface characterization parameters, which are then displayed or printed.

7. Preparation of Apparatus

7.1 Set the apparatus to display, and, if so equipped, record the chosen parameters in accordance with the manufacturers' instructions.

7.2 The evaluation length should be set to 5 sampling lengths. The sampling length and evaluation length should be set to 2.5 µm (0.1 in.) and 12.5 µm (0.5 in.), respectively.

7.3 The traversing length of the apparatus should be set (or manufacturer preset) to include pre-travel and post-travel segments, usually equal to one sampling length at the beginning and one sampling length at the evaluation length. These portions of a traverse are, however, discarded by the instrument in its calculation of surface parameters.

7.4 The apparatus should be adjusted (if necessary) to a deadband width in the range 1.0 to 1.25 µm (40 to 50 µin.). The choice of deadband for profiles as large as those discussed in this standard will have little effect on the measurements.

7.5 The apparatus should be calibrated regularly using a standard calibration block available from the equipment manufacturer using their written calibration setup procedure (Fig. 1).

[4] Research Report to be developed with a listing of manufacturers.

8. Preparation of the Sample

8.1 Select a 15 by 15 cm (6 by 6 in.) area of the surface to be tested that is visibly free from obvious defects such as scratches, deep marks, or other construction or corrosion defects.

8.2 Using a stiff nylon bristle brush, remove any dust or abrasive particles from the surface in the selected sample evaluation area. If not removed, such dust and micronic metallic particles may cause damage to the stylus and erroneous readings.

9. Calibration and Standardization

9.1 Precision reproductions of standard surface profiles such as those used by the manufacturer of the equipment, or described in their operational literature, may be used as calibration standards for the apparatus.

10. Procedure

10.1 Obtain an initial trace measurement (3 parameters), then four more to either side and above and below the first, about 3 cm (1 in.) away (total of 15 parameters).

10.2 If the stylus is prevented from making a complete trace due to a physical interference, such as a deep scratch on the surface, move the apparatus to a close adjacent area away from the obvious defect and repeat the trace.

10.3 Record the 15 parameters resulting from these five traces (3 parameters per trace).

11. Calculation and Interpretation of Results

11.1 Calculate the five measurement average for each of the three parameters.

12. Report

12.1 At a minimum, the report should contain the following items:

12.1.1 The sampling length and evaluation length,

12.1.2 Jobsite and location at which the measurement was made, and

12.1.3 The values of the five trace measurements of the three parameters measured (*Rt*, *Rmax*, *Pc*) and their averages.

12.2 A typical (illustrative) report form is shown in Fig. 2.

13. Precision and Bias

13.1 *Precision*—Portable stylus devices of the kind discussed here are relatively accurate instruments. The primary source of error arises with the fact that successive measurements of the same surface are not likely to be made at precisely the same location.

13.1.1 *Repeatability*—In a series of tests, in which a representative portable stylus roughness tester repeatedly measured the identical location on a grit-blasted surface, the observed percent standard deviations for 5 successive measurements were as follows: *Rmax* 9 %, *Rt* 5 %, *Pc* 0 %.

13.1.2 *Reproducibility*—In a series of tests in which different locations on a grit blasted surface were measured with a representative portable stylus roughness tester, the observed